

CHAPTER 4

2001 IN-PLANT FISH ASSESSMENT

INTRODUCTION

This chapter reports on fish impingement at the San Onofre Nuclear Generating Station (SONGS) in compliance with National Pollutant Discharge Elimination System (NPDES) requirements. The term "impingement" refers to entrapped fish that are killed in the SONGS cooling system and are removed by traveling screens. This chapter summarizes in-plant fish collection data for the year 2001 at San Onofre Units 2 and 3. San Onofre Unit 1 was taken out of service in 1992 and did not operate in 2001. Since circulating water pumps were not in service in 2001, no fish impingement samples could be taken, nor are they required by the NPDES permit.

Also included in this chapter is a report on the operation and effectiveness of "Fish Chase" procedures carried out in 2001 as a means of increasing fish survival at SONGS. The "Fish Chase" is a procedure used at SONGS to remove as many fish as possible from the circulating water system before heat treatment procedures are begun to eliminate fouling organisms from the system¹.

Fish enter Units 2 and 3 of the generating station via seawater intakes supplying cooling water to the station. Most of the fish are guided through the intake screenwell to the fish return system and are returned to the ocean alive. Those remaining are impinged on the traveling screens and are deposited in containers for disposal. Estimates of the total number and weight of fish impinged during normal plant operation, including heat treatment, and analysis of size (age) and sex structure of select impinged species are presented in this report for Units 2 and 3 at SONGS.

¹ Information in this report regarding the Fish Chase procedure also meets requirements of Condition B of the coastal development permit for SONGS (permit no. 6-81-330-A, formerly 183-73 issued by the California Coastal Commission.

METHODS

The analytical approach for this section utilizes tabular summaries of the number of individuals and biomass of fish impinged during normal operations and heat treatments. The total annual normal operation catch is calculated by multiplying the number of fish sampled during quarterly 24-hour sample periods by the total amount of sea water pumped during the year by the amount of water sampled during the 24-hour samples. Fish collected during heat treatments are added to the annual total. In other words:

$$I_1 = i (f_a / f_s) + h_a$$

Where:

I_a = Estimated total impingement for the year.

i = Impinged fish in sample(s) during year.

f_a = Amount of sea water pumped during the year.

f_s = Total amount of sea water pumped during sample periods.

h_a = Impinged fish in heat treatments during year.

In 1999, a new NPDES permit was issued to the San Onofre Nuclear Generating Station that reduced the requirement for fish impingement monitoring from monthly sampling to quarterly sampling. This change went into effect in August 1999. For this reason, normal operation samples were taken during each of the four calendar quarters in 2001 (January-March; April-June; July-September; and October-December. Monthly impingement was estimated by assuming the quarterly normal operation samples were representative of each of the months in the sampled quarter. Heat treatment fish loss is then added to the months during which the heat treatments occurred.

Length-frequency distributions of select species impinged in 2001 are constructed using samples of a maximum of 125 individuals for each normal operation and heat treatment sample. Fish were measured to the nearest millimeter. Sex ratios are estimated based on sub-samples of a maximum of 50 individuals per sample. Data are presented separately for each unit.

*minimum
would be
more useful*

HEAT TREATMENT SAMPLES

Heat treatments at San Onofre involve recirculating approximately two-thirds of the normal discharge flow back through the condenser to achieve a temperature of 105°F (41°C) in the screenwell to control biofouling. The intake conduit is heat treated in this manner on an as-required schedule based upon a biofouling growth model (LCMR 1977) and operational requirements of the plant. During the heat treatment process, fish residing in the screenwell die due to the elevated temperatures. The dead fish are removed by screens and collected by biologists who separate them by species. They are then counted, weighed, and sub-samples are measured and their sex determined.

FISH CHASE

A "fish chase" procedure has been developed at SONGS to reduce the impact on fish populations by minimizing the number of fish killed during heat treatments.

Many fish accumulate in the cooling water system between heat treatments, often residing in habitat provided by gate slots and other structures within the system. Without the "fish chase" procedure, all fish residing in the circulating water system at the time of the heat treatment likely would be killed.

The fish chase is a procedure unique to SONGS. It was developed to allow live fish to move out of the circulating water system before beginning the heat treatment. This is accomplished by slowly manipulating cross-over gates in the vicinity of the screenwell, where most of the fish reside. This operation re-circulates effluent water so that the water is slowly warmed. The gate manipulations also create eddy currents that will dislodge fish that have congregated in areas of low flow. The elevated temperatures and new flow patterns are intended to agitate fish enough that they will seek new habitat and will find their way into the fish return elevator for release back to the ocean. The fish chase is monitored by a biologist to assure that the fish are not overly stressed by the procedure. Engineers, operators and biologists are continuing to improve on the effectiveness of the fish chase by experimenting with various combinations of temperature and gate changes.

NORMAL OPERATION

Normal plant operation samples of fish are collected according to the frequency required by the station's NPDES permit, except during periods when the units are not in service due to refueling or maintenance. These 24-hour samples are intended to be representative of the amount of fish that enter the plant during a "normal" day's operation. In 2001, samples were taken quarterly throughout the year at both Units 2 and 3.

FISH RETURN SYSTEM

At Units 2 and 3, fish are guided via vanes and louvers to the fish return chamber where an elevator raises them to the surface of the intake screenwell and releases them via a sluiceway back to the ocean. Previously reported studies (SCE, 1988; Love, *et al*, 1989) assessed the effectiveness and survivorship of the fish return system. In 1999, additional studies of the fish return system were conducted as part of a special study for the California Coastal Commission. No fish return samples were taken in 2001.

The fish return system is operated by equipment operators at least twice daily and operations are logged on daily status sheets (Form SO123-0-10) (M. J. Johnson, Personal Communications).

DATA ANALYSIS

Analysis of impingement catch involves (1) estimating the catch of all fish species occurring during the year, (2) describing the length-frequency distributions of commonly occurring species,

and (3) describing sex ratios of commonly occurring species. All weight, count, length measurement and gender determination data are provided in the 2001 Annual Data Report. This chapter of the Analysis Report presents catch data for the 15 most common species and length and sex data for species believed to be of particular interest to resource managers, assuming sufficient data exists for meaningful analysis.

The calculation used to determine the annual impingement catch in weight and numbers of fish during normal operation and heat treatment was described earlier in this section.

Fish released during the fish chase procedure are counted by biologists as the fish are raised in the fish return elevator. Biomass is determined by applying the values measured for fish taken in the subsequent heat treatment samples. That is, fish returned via the fish return system are assumed, on average, to weigh the same as fish taken in the following heat treatment.

Size structure and sex ratios of select species are examined using length-frequency histograms and sex ratio tables developed from data gathered during impingement sampling.

RESULTS AND DISCUSSION

SUMMARY OF PLANT OPERATIONS

The monthly operational status of each unit in 2001 is summarized in Table 4-1. The table shows the number of gallons of seawater pumped per month. The amount of power produced at the station is not necessarily related to the volume of seawater pumped. This is because circulating water pumps may have to be operated even when the station is not producing power and the pumps operate at only one speed whereas the plant may not always be run at maximum capacity.

Table 4-1. Monthly Circulating Water Flow in 2001.

Month	Unit 1 10 ⁶ gallons	Unit 2 10 ⁶ gallons	Unit 3 10 ⁶ gallons
January	157.91	37,783.66	7,373.55
February	142.31	34,127.78	15,239.69
March	157.58	37,782.48	18,890.41
April	152.54	36,563.25	18,281.19
May	157.84	37,782.70	15,209.50
June	152.62	36,563.59	36,562.79
July	157.64	37,782.14	37,781.12
August	157.71	37,782.41	37,781.31
September	152.47	36,561.90	36,563.54
October	157.61	30,172.17	37,782.22
November	152.17	36,563.51	36,561.81
December	157.11	37,782.50	37,781.21
Total	1,855.49	437,248.10	335,808.34

ANNUAL IMPINGEMENT ESTIMATE

Unit 1

Fish impingement at Unit 1 is assumed to be zero since no circulating water pumps were operated in 2001. Flows resulting from operation of service water pumps are negligible (equivalent to about four days of operation for the entire year) and insufficient to create enough flow velocity to entrain or impinge fish.

Unit 2

The 2001 annual impingement estimate for Unit 2 is based on four quarterly normal operation impingement samples and eight heat treatment samples conducted during the year. Appendix A lists all normal operation and heat treatment samples collected at Unit 2 in 2001. Table 4-2 shows the estimated monthly abundance of the 15 most abundant fish species and all species combined in 2001. Table 4-3 presents the estimated monthly biomass of the top 15 fish species by weight in kilograms. Monthly abundance and biomass of all species occurring at SONGS Unit 2 in 2001 are presented in detail in Appendices B and C, respectively.

A total of 63 species of fish were counted and weighed at Unit 2 in 2001. When weighted by the total amount of seawater used by Unit 2 in 2001, the estimated fish impingement was 1,944,408 individuals weighing 5,810 kilograms. The top 15 species accounted for 99.9% of the total number and 99.1% of the total weight. Northern anchovy were by far the most common species contributing 88% of the total number of fish and 60.1% of the total weight. Queenfish were the next most abundant species, contributing 10.1% of the total number of fish and 28.4% of the biomass.

Unit 3

The 2001 annual impingement estimate for Unit 3 is based on four normal operation impingement samples and five heat treatment samples conducted during the year. Due to station maintenance and repairs, Unit 3 flow volume was reduced to approximately one half of normal flow from January through May, 2001. Table 4-4 shows the estimated monthly abundance of the 15 most abundant fish species and all species combined in 2001. Table 4-5 presents the estimated monthly biomass of the top 15 fish species by weight in kilograms. A list of all normal operation and fish return samples taken in 2001 are presented in Appendix A. Monthly abundance and biomass of all species occurring at SONGS Unit 3 in 2001 are presented in detail in Appendix D and E, respectively.

A total of 46 species of fish were counted and weighed at Unit 3 in 2001. When weighted by the total amount of seawater used by Unit 3 in 2001, the estimated fish impingement was 1,616,585 individuals weighing 11,560.1 kilograms. The top 15 species accounted for 99.9% of the total number and 99.5% of the total weight. Northern anchovy was the most numerous species contributing 73.4% of the total number of fish (33.1% of the total weight). Queenfish contributed the most biomass, with 36.5% of the total weight (24.6% of the total count).

Table 4-2. Estimated Monthly Count of Fish Impinged at Unit 2 in 2001

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
NORTHERN ANCHOVY	31	28	31	253	248	240	4136	4164	6572	474289	627291	594185	1711468
QUEENFISH	21483	19404	21482	15770	13546	13109	22881	22840	22050	10100	12663	14539	209867
PACIFIC SARDINE	0	0	0	0	1	0	31	31	30	3614	4452	4526	12684
SALEMA	93	84	93	193	0	0	229	134	40	25	243	175	1309
YELLOWFIN CROAKER	0	0	0	17	0	0	36	149	55	248	366	421	1291
DEEP BODY ANCHOVY	62	56	62	0	0	0	0	0	31	223	423	325	1182
SARGO	0	0	0	16	0	0	120	90	582	0	273	42	1123
PACIFIC BUTTERFISH	62	56	62	9	0	0	156	413	159	25	32	32	1006
WHITE CROAKER	0	0	0	76	0	0	71	362	36	0	34	105	684
JACK MACKEREL	0	0	0	7	0	0	98	119	96	74	90	93	577
WALLEYE SURFPERCH	0	0	0	115	93	90	5	15	4	0	38	61	421
JACKSMELT	93	84	93	84	0	0	0	6	0	0	4	14	378
SPECKLEFIN MIDSHIPMAN	31	28	31	45	31	30	31	34	34	0	1	3	299
BARRED SAND BASS	0	0	0	23	0	0	9	5	55	25	68	63	248
WHITE SEAPERCH	0	0	0	64	62	60	3	32	3	0	11	7	242
Total of top 15 species	21,855	19,740	21,854	16,673	13,980	13,529	27,806	28,394	29,747	488,621	645,989	614,591	1,942,779
Total of all 63 species	21948	19824	21947	16867	13980	13529	27987	28564	29953	488696	646229	614885	1944408

Table 4-3. Estimated Monthly Weight (Kgs) of Fish Impinged at Unit 2 in 2001

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
NORTHERN ANCHOVY	0.37	0.35	0.37	0.87	0.78	0.75	11.15	11.02	15.14	414.67	1177.80	1858.29	3491.56
QUEENFISH	194.59	182.04	194.59	146.41	98.02	94.86	153.63	151.05	144.53	31.46	89.97	168.07	1649.22
SARGO	0.00	0.00	0.00	0.28	0.00	0.00	39.71	21.90	136.02	0.00	35.60	2.43	235.93
YELLOWFIN CROAKER	0.00	0.00	0.00	0.03	0.00	0.00	11.55	62.53	10.36	0.94	7.59	10.84	103.83
SPECKLEFIN MIDSHIPMAN	8.09	7.57	8.09	0.90	0.47	0.45	4.59	6.63	5.62	0.00	0.77	0.00	43.18
PACIFIC SARDINE	0.00	0.00	0.00	0.03	0.00	0.00	1.86	1.86	1.80	4.49	11.69	20.12	41.85
JACKSMELT	8.96	8.38	8.96	7.43	0.00	0.00	0.00	0.28	0.00	0.64	1.75	3.30	39.69
SALEMA	0.53	0.49	0.53	4.32	0.00	0.00	11.76	8.57	2.20	0.03	9.27	0.65	38.34
PACIFIC BUTTERFISH	1.89	1.77	1.89	0.30	0.00	0.00	1.57	12.02	1.53	0.24	0.62	1.06	22.89
WHITE CROAKER	0.00	0.00	0.00	2.19	0.00	0.00	4.18	10.83	1.86	0.00	0.89	1.67	21.61
CHUB MACKEREL	0.00	0.00	0.00	0.06	0.00	0.00	6.52	5.67	5.34	0.49	1.25	2.24	21.56
BARRED SAND BASS	0.00	0.00	0.00	5.20	0.00	0.00	4.50	1.03	5.69	0.00	2.50	2.40	21.31
TOPSMELT	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.52	0.93	2.70	6.11	10.31
BLACK PERCH	0.00	0.00	0.00	3.08	0.00	0.00	3.68	0.53	0.83	0.00	0.61	0.35	9.09
WALLEYE SURFPERCH	0.00	0.00	0.00	2.18	1.05	1.02	0.27	0.25	0.05	0.00	1.38	1.75	7.96
Total of top 15 species	214.4	200.6	214.4	173.3	100.3	97.1	255.0	294.2	331.5	453.9	1344.4	2079.3	5758.3
Total of all 63 species	216.11	202.17	216.11	180.53	100.50	97.26	260.16	300.59	340.01	454.87	1354.89	2086.82	5810.00

Table 4-4. Estimated Monthly Count of Fish Impinged at Unit 3 in 2001

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
NORTHERN ANCHOVY	6	13	16	2,490	2,072	4,983	56,981	71,207	55,085	333,303	342,033	319,006	1,187,193
QUEENFISH	8,085	16,710	20,712	5,415	4,505	11,222	69,255	69,654	65,886	42,275	42,659	41,542	397,919
PACIFIC SARDINE	0	0	0	0	0	0	837	837	810	1,395	1,353	1,395	6,627
SALEMA	24	50	62	0	0	0	4,915	114	30	114	73	31	6,092
YELLOWFIN CROAKER	0	0	0	15	12	37	2,327	2,321	0	111	67	0	4,890
PACIFIC BUTTERFISH	6	13	16	0	0	0	1,004	987	900	9	6	0	2,940
WHITE CROAKER	12	25	31	180	150	361	426	746	270	174	443	93	2,911
DEEP BODY ANCHOVY	12	25	31	0	0	0	0	531	0	475	434	372	1,881
SARGO	0	0	0	0	0	10	52	1,569	0	187	30	0	1,848
JACK MACKEREL	0	0	0	0	0	0	221	237	210	6	4	0	678
JACKSMELT	73	151	187	30	25	60	1	5	0	33	33	31	630
WALLEYE SURFPERCH	0	0	0	60	50	132	56	39	30	13	23	0	403
GIANT KELPFISH	0	0	0	0	0	0	127	130	120	5	4	0	386
WHITE SEAPERCH	0	0	0	0	0	1	73	75	60	36	43	31	319
BARRACUDA	0	0	0	0	0	0	0	0	0	116	69	31	216
Total of top 15 species	8,219	16,987	21,056	8,190	6,814	17,484	136,275	148,452	123,400	378,252	387,275	362,532	1,614,935
Total of all 46 species	8,225	16,999	21,072	8,265	6,876	17,659	136,378	148,599	123,460	378,602	387,671	362,780	1,616,585

Table 4-5. Estimated Monthly Weight (Kgs) of Fish Impinged at Unit 3 in 2001

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
QUEENFISH	45.85	94.76	117.46	63.07	52.47	131.20	834.62	844.41	782.83	423.74	426.86	403.18	4220.45
NORTHERN ANCHOVY	0.05	0.10	0.12	5.62	4.68	11.28	137.10	137.03	132.61	1120.42	1170.29	1102.57	3821.88
YELLOWFIN CROAKER	0.00	0.00	0.00	2.79	2.32	6.95	1015.33	822.40	0.00	16.45	6.16	0.00	1872.40
SARGO	0.00	0.00	0.00	0.00	0.00	2.28	14.13	440.83	0.00	43.20	2.51	0.00	502.95
SALEMA	0.17	0.35	0.44	0.00	0.00	1.07	38.02	424.68	1.08	4.08	1.09	0.03	471.00
PACIFIC SARDINE	0.00	0.00	0.00	0.00	0.00	0.00	8.31	8.31	8.04	76.23	73.91	76.23	251.04
PIPEFISH	0.01	0.01	0.02	0.00	0.00	5.05	25.73	35.51	0.00	20.55	36.70	0.00	123.57
PACIFIC BUTTERFISH	0.14	0.29	0.36	0.00	0.00	0.00	27.17	26.75	23.82	0.30	0.14	0.00	78.97
WHITE CROAKER	0.21	0.43	0.53	0.93	0.77	1.86	6.61	22.43	2.73	2.72	7.53	0.37	47.13
JACKSMELT	6.27	12.95	16.06	0.75	0.62	1.50	0.01	0.28	0.00	1.02	1.07	0.93	41.46
GIANT SEABASS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	8.55	0.00	0.00	23.55
BARRED SAND BASS	0.00	0.00	0.00	0.00	0.00	0.00	1.18	2.79	0.00	2.78	6.50	0.00	13.25
DEEP BODY ANCHOVY	0.12	0.24	0.30	0.00	0.00	0.00	0.00	0.53	0.00	4.58	4.05	3.16	12.97
JACK MACKEREL	0.00	0.00	0.00	0.00	0.00	0.00	2.47	4.07	2.10	0.33	0.25	0.00	9.22
PLAINFIN MIDSHIPMAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.98	2.88	2.98	8.83
Total of top 15 species	52.8	109.1	135.3	73.2	60.9	161.2	2110.7	2785.0	953.2	1727.9	1739.9	1589.5	11498.7
Total of all 46 species	52.81	109.14	135.29	75.73	63.01	169.12	2117.82	2792.18	955.31	1744.88	1750.64	1594.19	11560.10

Heat Treatment Operations and "Fish Chase".

"Heat treatments" are conducted on an "as needed" basis at coastal generating stations to control the growth of fouling organisms such as mussels and barnacles. The timing of these operations is dependent on season, ocean temperature, and observed settlement and growth of fouling organisms. The operations typically occur about every six weeks. The water temperature within the station is elevated to a temperature that will be lethal to the fouling organisms within the plant. Since this temperature is also lethal to fish residing in the station, a special operation called a "fish chase" has been developed at San Onofre to cause fish to leave the station alive before the heat treatment begins. Table 4-6 summarizes the number and weight of fish returned to the ocean during the fish chase that occurs just prior to the heat treatment and the percent of those fish returned to the ocean compared to the number of fish killed during the heat treatment process at SONGS Units 2 and 3.

In 2001, a total of 3,931 kgs of fish were impinged during heat treatment operations at SONGS. At the same time, as a result of the "Fish Chase" procedure, 3,847 kgs of fish were successfully released back to the ocean prior to the heat treatments. The percentage of fish released varied among the heat treatments, but averaged 49.5%, by biomass, for the year. The percent of fish released during the fish chase varied from 9.4% to 81.8% of the total (i.e., heat treatment plus fish chase) biomass. The low release percentage for the 4/30/01 and 11/4/01 heat treatments at Unit 2 is believed to be a result of entrainment of fish during the heat treatment process, rather than an inefficient fish chase operation. For example, the 11/4/01 heat treatment contained 126.5 kilograms of northern anchovies, or 62.7% of the total biomass, while the previous fish chase had only 0.73 kilograms of northern anchovies. Anchovies are very well guided by the fish return system and are usually the first fish to be released. The first phase of the heat treatment did not have many anchovies, but later in the heat treatment a large number of anchovies appeared, indicated that they had entered the station during the heat treatment process. A summary of Fish Chase operations is presented in Table 4-7.

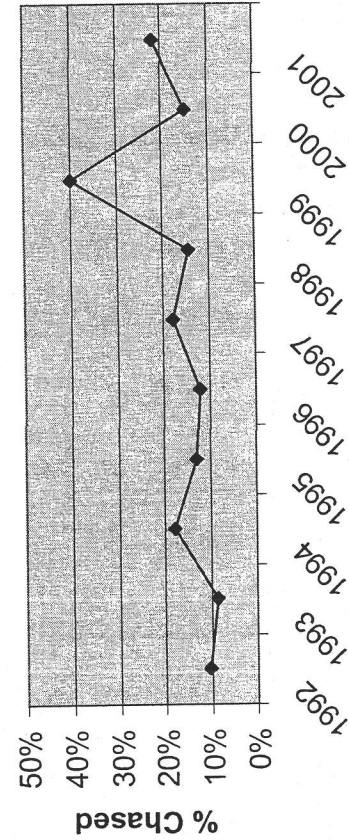
**Table 4-6. Fish Chase Efficiency by Heat Treatment
for Units 2 and 3 in 2001**

Unit	Date	Fish Chase Kilograms	Heat Treatment Kilograms	Percent Released
Unit 2	04/04/01	18.89	16.619	53.2%
Unit 2	04/06/01	4.89	4.629	51.4%
Unit 2	04/30/01	6.44	62.243	9.4%
Unit 2	07/07/01	290.34	94.245	75.5%
Unit 2	08/11/01	34.227	134.671	20.3%
Unit 2	09/23/01	307.25	179.525	63.1%
Unit 2	11/04/01	46.145	201.669	18.6%
Unit 2	12/16/01	66.035	49.241	57.3%
Unit 3	06/02/01	34.36	12.598	73.2%
Unit 3	07/14/01	1158.719	1104.96	51.2%
Unit 3	08/25/01	1173.048	1769.539	39.9%
Unit 3	10/07/01	582.79	130.074	81.8%
Unit 3	11/18/01	124.16	171.201	42.0%
Totals		3,847	3,931	49.5%

Table 4-7. Description of Fish Chase Operations in 2001

Unit	Date	Start Time	Intake Temp.	Max FC Temp.	Operational Status	# of Dumps	Elevator			Heat Treatment		
							Condition of fish	Number of Fish	Fish Biomass	Number of Fish	Fish Biomass	Comment
2	04/04/2001	1601	62	84	Cancelled	18	Good	88	18.89	490	16.619	Heat Treat cancelled. Possible sea lion
2	04/06/2001	1947	62	87	Good	14	Good	19	4.89	65	4.629	No unusual events
2	04/30/2001	0004	64	82.7	Good	18	Good	168	6.44	2787	62.243	No unusual events
2	07/07/2001	2005	64.4	85	Good	20	Good	1938	290.34	1072	94.245	No unusual events
2	08/11/2001	1209	68	85	Good	14	Good	2269	34.227	1655	134.671	No unusual events
2	09/23/2001	1207	62	85.9	Good	23	Good	2257	307.25	3909	179.525	No unusual events
2	11/04/2001	0745	59	84.5	Good	13	Good	845	46.145	54014	201.669	Mostly anchovies in heat treatment.
2	12/16/2001	0730	57	81	Good	20	Good	1076	66.035	49,241	2925	No unusual events
3	06/02/2001	1542	65	82.9	Good	20	Good	739	34.36	482	12.598	No unusual events
3	07/14/2001	1230	58.1	82	Curtailed	22	Good	3799	1158.719	4600	1104.96	Elevator jam after 22 lifts.
3	08/25/2001	1207	68	86.3	Good	22	Good	4594	1173.048	11543	1769.539	Mostly yellowfin croaker and sargo
3	10/07/2001	0903	65	85	Good	24	Good	8201	582.79	15812	130.074	No unusual events
3	11/18/2001	0818	60	84	Good	14	Good	2770	124.16	36599	171.201	Mostly anchovies in heat treatment.

Figure 4-1. Percent of Total Biomass Returned in Fish Chase



In Table 4-7 above, "Operational Status" provides information on the overall success of the fish chase procedure from an operational standpoint, i.e., whether it was completed as scheduled or not. "Condition of Fish" is a qualitative evaluation of how the fish appeared as they were released. A designation of "Good" means that less than 1% of the fish released appeared weakened or dead. The target temperature for a fish chase is usually 83°F. (28.3° C.) However, higher temperatures may be necessary to remove warm water species such as yellowfin croaker, sargo and zebra perch. In 2001, maximum temperatures ranged from 81° to 87° F.(27.2° to 30.6° C.). Graphs of temperature curves for each fish chase are presented in Appendix F. Table 4-8 presents a summary of fish released during the Fish Chase operations in 2001. The table provides the percent returned by numbers and biomass for the 15 most common species based on biomass. Appendix G provides the same information for all species taken at SONGS in 2001. Appendix H lists species that may be of special interest to some researchers and resource managers.

Table 4-8 Summary of Fish released During Fish Chase Operations in 2001 (Top 15 species)

Common Name	Unit 2 Fish Chase		Unit 3 Fish Chase		Unit 2 Heat treat		Unit 3 Heat treat		% Returned	% Returned
	Number	Kgs	Number	Kgs	Number	Kgs	Number	Kgs	by Count	by Biomass
NORTHERN ANCHOVY	4154	8.246	7255	12.528	55541	132.245	47676	121.226	9.95%	7.57%
QUEENFISH	266	4.675	1066	18.105	6230	126.227	6331	123.538	9.59%	8.36%
YELLOWFIN CROAKER	879	137.369	5732	1795.79	434	96.306	4833	1861.707	55.66%	49.68%
SALEMA	798	48.654	2257	123.431	953	36.57	5719	466.632	31.41%	25.48%
SARGO	1724	391.196	2858	732.194	1123	236.159	1848	502.951	60.66%	60.32%
WHITE CROAKER	82	2.276			592	16.552	1049	32.921	4.76%	4.40%
DEEP BODY ANCHOVY					230	3.008	708	2.933	0.00%	0.00%
BARRED SAND BASS	254	38.958	182	22.318	162	21.312	125	13.248	60.30%	63.94%
PACIFIC BUTTERFISH			34	1.173	277	10.946	146	5.13	7.44%	6.80%
WALLEYE SURFPERCH	78	2.505	93	2.98	148	4.863	81	2.635	42.75%	42.25%
ZEBRA PERCH	94	32.058	230	130.11	2	0.787	6	3.417	97.59%	97.47%
BLACK PERCH	77	6.711	51	4.639	92	9.091	16	1.259	54.24%	52.30%
ROCKPOOL BLENNY	2	0.04			174	0.56	17	0.104	1.04%	5.68%
SPOTFIN CROAKER	79	25.29	99	35.13	14	0.778			92.71%	98.73%
BARRACUDA			1	0.5	27	0.864	124	3.609	0.66%	10.05%
Totals for Top 15 species	8487	697.98	19858	2878.90	65999	696.27	68679	3141.31	17.39%	48.24%
Totals for all 69 species	8655	773	20103	3073	66916	743	69036	3188	17.46%	49.45%

Fish Return System Operation

The SONGS fish return system is normally operated twice per day by station operators. It is a routine part of station operations that is logged on daily status sheets (Form SO123-0-10) (M. J. Johnson, Personal Communication). A summary of exceptions to daily operability of the fish return system in 2001 is detailed in Table 4-8.

Prior to 1999, no quantitative biological data on the efficiency of the fish return system had been collected since 1994. However, eleven years of data were collected from 1984 through 1994, and a special study provided additional information in 1999. A summary of the return efficiency of the fish return system during those years is presented in Table 4-9. Return efficiency is the percent of fish returned to the ocean alive during normal operation compared to the number of fish impinged and does not include fish returned during the "fish chase". No fish return samples were taken in 2001.

Table 4-9. Operating status of the Fish Return System in 2001.

Unit	Total Hours FRS Out of Service in 2001	Reason FRS was Out of Service	% System Availability in 2001
2	48	Hydraulic drive PM	99
3	192	Hydraulic pump repair	98

Table 4-10. Fish Return Efficiency 1984-1994 and 1999

Year	Unit 2 Percent Returned	Unit 3 Percent Returned
1984	96.50	95.40
1985	88.30	60.10
1986	75.00	69.90
1987	65.00	67.80
1988	80.00	68.50
1989	41.60	58.40
1990	51.50	36.60
1991	75.40	66.30
1992	74.40	59.30
1993	83.00	78.00
1994	87.70	78.40
1999	72.40	68.22

LENGTH FREQUENCY ANALYSIS

Figures 4-2 through 4-5 present length-frequency distributions of queenfish, northern anchovy, white croaker and Pacific sardine collected in-plant at Units 2 and 3 during 2001. These species were selected either because of their predominance in the catch (e.g., queenfish and northern anchovy) or because of their interest to resource managers (e.g., Pacific sardine and white croaker). Length data for all other species is provided in the 2001 data report.

Fig. 4-2. Queenfish Length Distribution

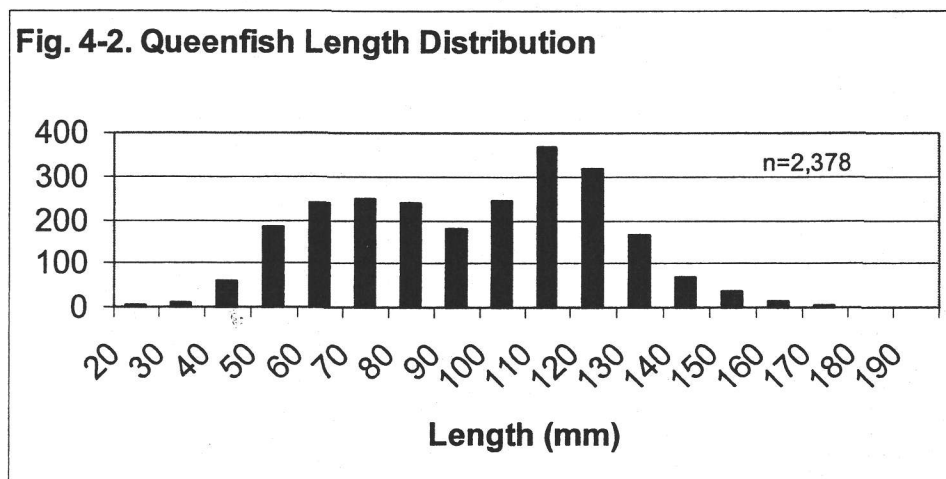


Fig. 4-3. Northern Anchovy Length Distribution

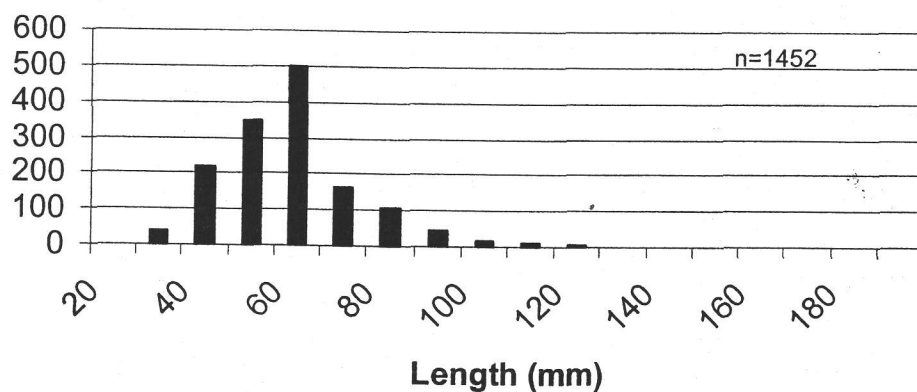


Fig. 4-4. White Croaker Length Distribution

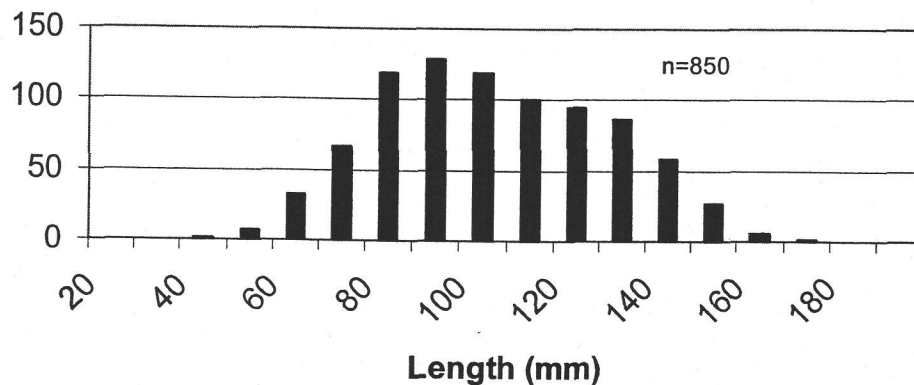
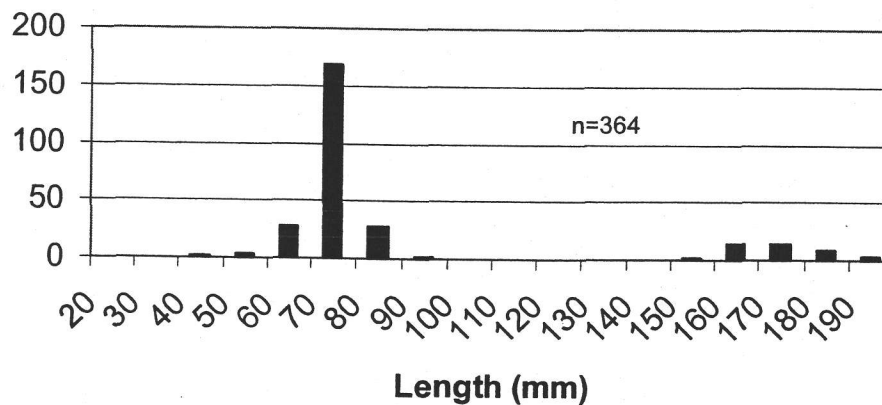


Fig. 4-5. Pacific Sardine Length Distribution



As in most years, northern anchovy and queenfish were numerous in 2001 and accounted for over 98% of the total catch at SONGS, by number.

Northern anchovy are small, short-lived fish typically found in schools near the surface during the day, then dispersing through the water column at night. It is probably during this dispersal at night that they are most likely to be entrained into generating station intakes. They rarely exceed four years in age and seven inches in length, although individuals as old as seven years and nine inches have been recorded. There is a great deal of regional variation in age composition and size at age with older, larger, fish found at relatively offshore and northerly locations. In warm years relatively old and large fish are found farther north than during cool years (Leet, et al, 1992). At SONGS in 2001, northern anchovy lengths ranged mostly from 30 to 130 mm throughout the year, with a modal peak at 60 mm. The smaller size class (around 50 mm) correlates to an age of 1.5 to 2.5 months (Sakagawa and Kimura 1976). Large numbers of northern anchovies were seen at SONGS in 1999 and 2001, but fewer were seen in 2000. Though usually abundant, the northern anchovy biomass fluctuations may be a result of global changes such as El Niño/La Niña conditions or just the patchiness of their distribution along the coast.

Queenfish school in shallow water during the day, often in the shadow of reefs or kelp, then disperse and move offshore at night when they feed actively (Love, 1991). It is during these nocturnal migrations and dispersal in the water column that many of the queenfish are entrained into generating station intakes (Johnson, et al., 1976). The annual abundance of queenfish has fluctuated significantly from year to year with an apparent relationship with ENSO (El Niño/La Niña) events. Though abundance has remained generally strong during both warm and cool water periods, there were marked declines during the strong warm-water ENSO events of 1982-83, 1987 and 1997-98. In 1999 and 2000, cold water years, queenfish abundance was approximately double that of 1998. In 2001, following a return to more normal temperatures, queenfish abundance returned to the 1998 level. Queenfish lengths ranged from 20 to 180 mm. The length distribution was generally bi-modal, however the modality is obscured by growth of the fish during the year. The primary modes were at 70 and 120 mm representing mostly Age 0 and Age 1 individuals. Recruitment of young-of-the-year (YOY) appeared strong in 2001.

Pacific sardines continued to decline in number in 2001 when compared to 1998 and 1999, but were similar in number to 2000. As in previous years, numbers continued to be higher at Unit 3 than at Unit 2, a phenomenon that is difficult to explain. In 2001, most of the sardines ranged from 40 to 190 mm, but, unlike 2000, showing two distinct modes at 70 and 170 mm, indicating some success in recruitment in 2001.

Unlike queenfish, whose abundance has fluctuated from year to year but has not shown any long-term decline, white croaker abundance over the same period exhibited an overall downward trend, until 1999. In 1999, perhaps due to the colder water temperatures, white croaker abundances increased to nearly 10 times that of 1998. In 2000 the trend continued with numbers ten times greater than in 1999. In 2001 white croaker numbers declined dramatically in the impingement catch, but increased significantly in the trawl catch (see chapter 5). This may indicate that white croaker abundances in the vicinity of SONGS are still high, and perhaps increasing, but they are remaining further offshore.

White croaker often co-occur with queenfish (Love, 1991) and exhibit similar diurnal dispersal patterns. Seasonal abundance data from impingement sampling data support observations by Allen and DeMartini (1983) that white croaker may move offshore into deeper waters during winter months. In 2001, the white croaker length frequency distribution appears unimodal but likely obscures modes of cohorts ranging in age from 0 to at least 3 years. Recruitment does not appear to be as strong in 2001 as it was in 2000.

SEX COMPOSITION

Sex ratios of fish impinged at Units 2 and 3 are summarized in Table 4-11. As observed in past years, females frequently outnumbered males for many of the species studied. This is especially true of the perches, northern anchovies, and queenfish. This may be due to increased vulnerability to impingement of gravid females, especially the embiotocids that have impaired swimming ability. White croaker also had more females than males. In contrast, Pacific sardines were more commonly males than females. All these characteristics are consistent with data from previous years.

Table 4-11. Count by Sex of Fish Captured at SONGS in 2001.

Common Name	Gender	
	Female	Male
BARRED SAND BASS	28	8
BLACK CROAKER	10	4
BLACK PERCH	65	16
CALIFORNIA SHEEPHEAD	1	0
DEEP BODY ANCHOVY	1	0
HORN SHARK	0	1
KELP BASS	1	3
NORTHERN ANCHOVY	25	11
PACIFIC BUTTERFISH	91	75
PACIFIC SARDINE	14	25
PILE PERCH	1	0
QUEENFISH	554	305
ROCK WRASSE	3	3
ROUND STINGRAY	1	0
RUBBERLIP SEAPERCH	1	1
SARGO	170	129
SHINER PERCH	45	35
SPOTTED SAND BASS	1	0
WALLEYE SURFPERCH	97	88
WHITE CROAKER	241	94
WHITE SEA BASS	0	1
WHITE SEAPERCH	25	6
YELLOWFIN CROAKER	191	216

TOTAL IMPINGEMENT

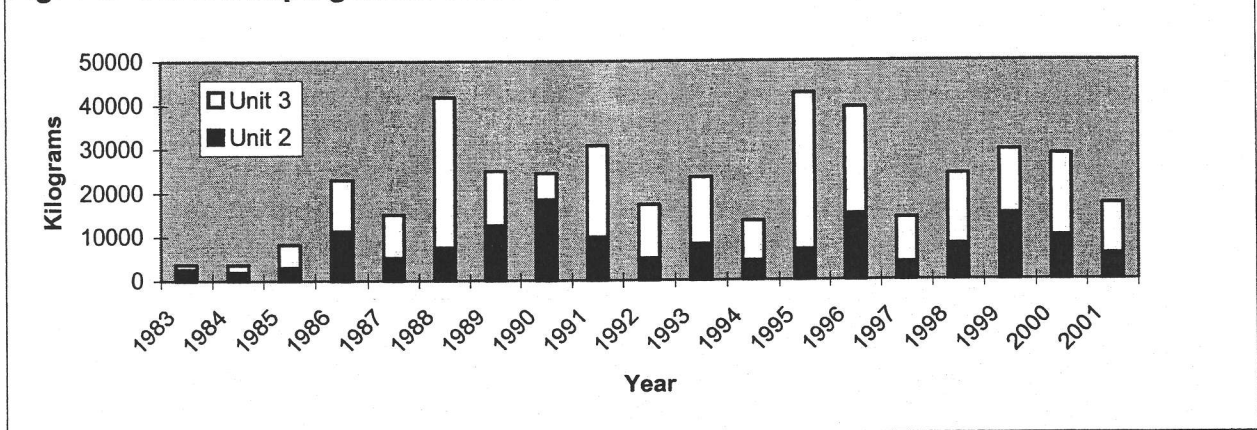
The total impingement fish loss for 2001 is the sum of the estimated annual impingement loss during normal operation and fish impinged during heat treatment. Estimated annual impingement for Unit 2 in 2001, for all species combined, was 1,944,408 fish weighing 5,810 kilograms. Annual impingement at Unit 3 was 1,616,585 fish weighing 11,560 kilograms (Table 4-12).

Table 4-12. Total number and weight of fish caught at San Onofre Units 2 & 3 in 2001.

Unit	Normal Operation Impingement Total	Heat Treatment Total	Total Fish Impingement
2 (Count)	1,877,491	66,917	1,944,408
2 (Biomass)	5,245	565	5,810
3 (Count)	1,547,549	69,036	1,616,585
3 (Biomass)	8,372	3,188	11,560

Compared to previous years of operation, the total 2001 impinged biomass (17,370 kg) was 23.5% lower than the 18-year average of 22,719 kg recorded since Units 2 and 3 began operation, but was within the normal variation of samples in past years. Changes in impingement catch at SONGS are likely the result of large-scale climatological and oceanographic perturbations unrelated to operation of the generating station. The impingement data collected at SONGS is frequently used by resource managers as an indicator of natural fluctuations in near-shore fish populations.

Fig. 4-6. SONGS Impingement 1983-2001

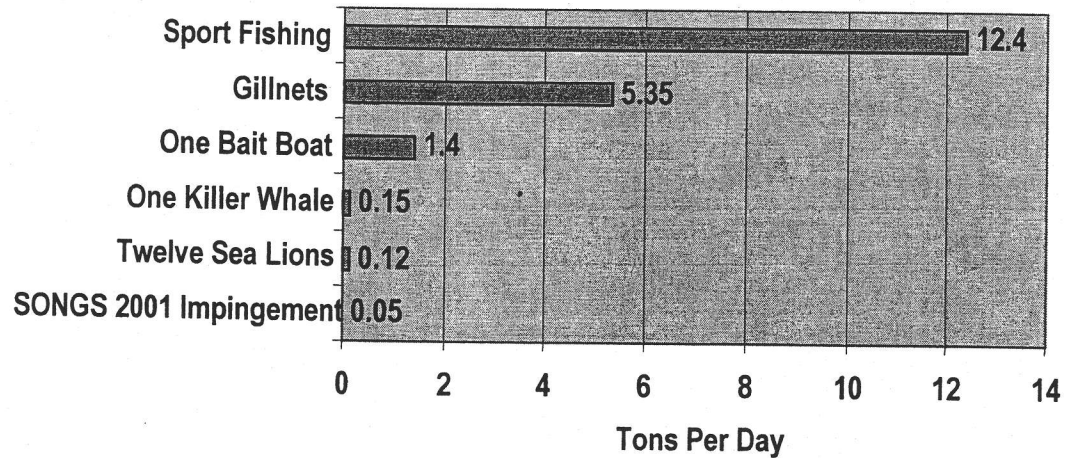


COMPARISON TO OTHER SOURCES OF FISH LOSS

This report provides an estimate of fish loss due to impingement resulting from the use of seawater as a source of cooling water for the San Onofre Nuclear Generating Station. In order to put these losses in perspective, it may be useful to compare the impingement losses with other losses routinely experienced by Southern California fish populations.

Figure 4-6 presents a variety of stresses on local fish populations and their relative magnitude in relation to SONGS impingement.

Figure 4-7. Comparison of Daily Losses.



Data source: ¹ 2001 Songs Annual Analysis Report; ²⁻³ "Marine Mammals of California" by A.E. Daugherty, 1979; ⁴ C. Cooney, Cal F&G, pers. com.; ⁵ Cal F&G/MMS computer data base; ⁶ U.S. Dept. of Commerce, Marine Rec. Fishery Statistics Survey, Pacific Coast 1981-1984 (within 3 miles of shore).

SUMMARY

IMPINGEMENT

Overall, the number and weight of fish impinged at San Onofre in 2001 was 23.5% lower than the 18-year average, but within the range of values recorded since Units 2 and 3 began operation. There is no indication that fish impingement at SONGS has significantly impacted the maintenance of a balanced, indigenous fish population in the receiving water, nor did it impair any beneficial uses dependent on the fisheries resources.

Unit 1

Fish impingement at Unit 1 is assumed to be zero since no circulating water pumps were operated in 2001. Flows resulting from operation of service water pumps are negligible (equivalent to less than 5 days of operation for the entire year) and insufficient to create enough flow velocity to entrain or impinge fish.

Unit 2

An estimated 1,944,408 individuals weighing a total of 5,810 kgs. were impinged by Unit 2 based on four quarterly samples of normal operation and eight heat treatment samples conducted during 2001. Northern anchovies and queenfish comprised 99.1% of the catch by number and 88.5% of the catch by weight.

Unit 3

An estimated 1,616,585 individuals weighing a total of 11,560 kg were impinged by Unit 3 based on four quarterly samples of normal operation and five heat treatments in 2001. Northern anchovies and queenfish comprised 98% of the catch by number and 69.6% of the total weight.

FISH CHASE

A special procedure called a "fish chase" has been developed at San Onofre to cause fish to leave the circulating water system before heat treatments begin. In 2001, a total of 28,758 fish weighing 3,846 kgs. were successfully released back to the ocean prior to heat treatments.

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APPENDIX A

List of Normal Operation and Fish Return Samples at SONGS Units 2 & 3.

Appendix A. Heat Treatment and Normal Operation Samples Taken at Units 2&3 During 2001.					
Unit	Date	Sample Type	Number of Species	Number of Fish	Fish Biomass (Kgs.)
Unit 2	04/04/01	Heat Treatment	28	490	16.619
Unit 2	04/06/01	Heat Treatment	13	65	4.629
Unit 2	04/30/01	Heat Treatment	31	2,787	62.243
Unit 2	07/07/01	Heat Treatment	30	1,072	94.245
Unit 2	08/11/01	Heat Treatment	30	1,655	134.671
Unit 2	09/23/01	Heat Treatment	31	3,909	179.525
Unit 2	11/04/01	Heat Treatment	33	54,014	201.669
Unit 2	12/16/01	Heat Treatment	32	2,925	49.241
Unit 2	03/13/01	Normal Operation	9	708	6.971
Unit 2	06/12/01	Normal Operation	5	451	3.242
Unit 2	08/21/01	Normal Operation	9	868	5.352
Unit 2	11/27/01	Normal Operation	12	19,742	65.729
Unit 3	06/02/01	Heat Treatment	15	482	12.598
Unit 3	07/14/01	Heat Treatment	28	4,600	1104.96
Unit 3	08/25/01	Heat Treatment	28	11,543	1769.539
Unit 3	10/07/01	Heat Treatment	33	15,812	130.074
Unit 3	11/18/01	Heat Treatment	31	36,599	171.201
Unit 3	03/13/01	Normal Operation	8	1,349	8.661
Unit 3	06/12/01	Normal Operation	10	551	5.014
Unit 3	08/21/01	Normal Operation	12	4,115	31.876
Unit 3	11/27/01	Normal Operation	16	11,702	51.423

APPENDIX B.

**Estimated Monthly Number of Fish Impinged
at SONGS Unit 2 in 2001.**

Appendix B. Estimated Monthly Number of Fish at SONGS Unit 2 in 2001

Unit 2 Count Common Name	Extrapolated Catch Per Day Per Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
BARRACUDA	0	0	0	1	0	0	0	0	3	0	22	1	27
BARRED SAND BASS	0	0	0	23	0	0	9	5	55	25	68	63	248
BASKETWEAVE CUSK-EEL	0	0	0	4	0	0	0	0	0	0	0	0	4
BLACK CROAKER	0	0	0	1	0	0	1	0	11	0	29	18	60
BLACK PERCH	0	0	0	30	0	0	34	6	11	0	7	4	92
BLACKSMITH	0	0	0	9	0	0	4	4	8	0	8	16	49
BROWN ROCKFISH	0	0	0	2	0	0	0	0	0	0	1	0	3
CABEZON	0	0	0	7	0	0	19	5	1	0	0	0	32
CALIFORNIA BUTTERFLY RAY	0	0	0	0	0	0	0	0	0	0	0	0	0
CALIFORNIA CORBINA	0	0	0	0	0	0	0	0	0	0	1	1	2
CALIFORNIA GRUNION	0	0	0	1	0	0	1	1	1	0	0	0	4
CALIFORNIA HALIBUT	0	0	0	0	0	0	0	1	4	0	7	3	15
CALIFORNIA MORAY	0	0	0	0	0	0	0	0	0	0	0	0	0
CALIFORNIA SCORPIONFISH	0	0	0	16	0	0	38	39	39	0	10	3	145
CALIFORNIA SHEEPHEAD	0	0	0	1	0	0	0	1	0	0	0	0	2
CALIFORNIA TONGUEFISH	0	0	0	0	0	0	0	0	0	0	0	1	1
CHUB MACKEREL	0	0	0	1	0	0	38	32	30	25	30	32	188
DEEP BODY ANCHOVY	62	56	62	0	0	0	0	0	31	223	423	325	1182
GARIBALDI	0	0	0	1	0	0	0	0	0	0	0	0	1
GIANT KELPFISH	0	0	0	5	0	0	3	6	2	25	34	40	115
GIANT SEABASS	0	0	0	0	0	0	0	0	1	0	0	0	1
GRASS ROCKFISH	0	0	0	1	0	0	1	0	0	0	0	0	2
HALFMOON	0	0	0	0	0	0	0	0	0	0	0	0	0
HORN SHARK	0	0	0	0	0	0	0	0	0	0	0	0	0
HORNYHEAD TURBOT	0	0	0	1	0	0	0	0	0	0	0	0	1
JACK MACKEREL	0	0	0	7	0	0	98	119	96	74	90	93	577
JACKSMELT	93	84	93	84	0	0	0	6	0	0	4	14	378
KELP BASS	0	0	0	2	0	0	2	0	1	0	19	12	36
KELP PERCH	0	0	0	1	0	0	1	0	0	0	0	0	2
KELP PIPEFISH	62	56	62	1	0	0	1	0	0	0	0	1	183
KELPFISH	0	0	0	4	0	0	4	0	0	0	0	0	8
NORTHERN ANCHOVY	31	28	31	253	248	240	4136	4164	6572	474289	627291	594185	1711468
PACIFIC BUTTERFISH	62	56	62	9	0	0	156	413	159	25	32	32	1006
PACIFIC SANDDAB	0	0	0	1	0	0	0	0	0	0	0	0	1
PACIFIC SARDINE	0	0	0	1	0	0	31	31	30	3614	4452	4526	12684
PILE PERCH	0	0	0	1	0	0	0	0	0	0	0	0	1
PIPEFISH	0	0	0	26	0	0	0	0	0	0	0	0	26
PLAINFIN MIDSHIPMAN	0	0	0	0	0	0	1	0	0	0	0	0	1
QUEENFISH	21483	19404	21482	15770	13546	13109	22881	22840	22050	10100	12663	14539	209867
ROCK WRASSE	0	0	0	0	0	0	4	2	0	0	1	1	8

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ROCKPOOL BLENNY	0	0	0	39	0	0	7	6	52	0	6	64	174
ROUND STINGRAY	0	0	0	0	0	0	0	0	0	0	0	0	0
RUBBERLIP SEAPERCH	0	0	0	0	0	0	0	1	0	0	0	0	1
SALEMA	93	84	93	193	0	0	229	134	40	25	243	175	1309
SARGO	0	0	0	16	0	0	120	90	582	0	273	42	1123
SCULPIN (Artedius sp.)	0	0	0	1	0	0	0	0	0	0	0	0	1
SENIORITA	0	0	0	7	0	0	8	0	0	0	1	1	17
SHINER PERCH	0	0	0	23	0	0	4	49	3	0	1	2	82
SLOUGH ANCHOVY	0	0	0	0	0	0	0	0	0	0	0	2	2
SPECKLEFIN MIDSHIPMAN	31	28	31	45	31	30	31	34	34	0	1	3	299
SPOTFIN CROAKER	0	0	0	0	0	0	0	0	0	0	14	0	14
SPOTTED KELPFISH	0	0	0	1	0	0	5	0	1	0	2	0	9
SPOTTED TURBOT	0	0	0	5	0	0	3	1	4	0	7	15	35
STAGHORN SCULPIN	0	0	0	0	0	0	0	1	0	0	0	0	1
STRIPED KELPFISH	0	0	0	0	0	0	0	14	0	0	0	0	14
TOPSMELT	0	0	0	1	0	0	0	0	23	25	38	76	163
TREEFISH	31	28	31	0	0	0	0	0	0	0	0	0	90
WALLEYE SURFPERCH	0	0	0	115	93	90	5	15	4	0	38	61	421
WHITE CROAKER	0	0	0	76	0	0	71	362	36	0	34	105	684
WHITE SEA BASS	0	0	0	0	0	0	1	0	11	0	2	1	15
WHITE SEAPERCH	0	0	0	64	62	60	3	32	3	0	11	7	242
YELLOWFIN CROAKER	0	0	0	17	0	0	36	149	55	248	366	421	1291
ZEBRA PERCH	0	0	0	0	0	0	1	1	0	0	0	0	2
	21948	19824	21947	16867	13980	13529	27987	28564	29953	488696	646229	614885	1944408

APPENDIX C.

**Estimated Monthly Catch in Kilograms of Fish
at SONGS Unit 2 in 2001.**

Appendix C. Estimated Monthly Catch in Kilograms at SONGS Unit 2 in 2001

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
BARRACUDA	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.02	0.43	1.70	1.99	4.30
BARRED SAND BASS	0.00	0.00	0.00	5.20	0.00	0.00	4.50	1.03	5.69	0.00	2.50	2.40	21.31
BASKETWEAVE CUSK-EEL	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
BLACK CROAKER	0.00	0.00	0.00	0.13	0.00	0.00	0.22	0.00	0.65	0.00	0.78	0.25	2.03
BLACK PERCH	0.00	0.00	0.00	3.08	0.00	0.00	3.68	0.53	0.83	0.00	0.61	0.35	9.09
BLACKSMITH	0.00	0.00	0.00	0.10	0.00	0.00	0.24	0.03	1.07	0.00	0.13	0.31	1.88
BROWN ROCKFISH	0.00	0.00	0.00	1.21	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	1.55
CABEZON	0.00	0.00	0.00	0.35	0.00	0.00	0.48	0.12	0.03	0.00	0.00	0.00	0.98
CALIFORNIA BUTTERFLY RAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CALIFORNIA CORBINA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03
CALIFORNIA GRUNION	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.05
CALIFORNIA HALIBUT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.14	0.00	0.41	0.45	1.35
CALIFORNIA MORAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CALIFORNIA SCORPIONFISH	0.00	0.00	0.00	2.03	0.00	0.00	1.10	0.70	1.20	0.00	1.41	0.28	6.72
CALIFORNIA SHEEPHEAD	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.39
CALIFORNIA TONGUEFISH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CHUB MACKEREL	0.00	0.00	0.00	0.06	0.00	0.00	6.52	5.67	5.34	0.49	1.25	2.24	21.56
DEEP BODY ANCHOVY	0.12	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.46	0.51	3.48	2.61	7.42
GARIBALDI	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
GIANT KELPFISH	0.00	0.00	0.00	0.19	0.00	0.00	0.11	0.25	0.10	0.06	0.27	0.66	1.63
GIANT SEABASS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.06	0.00	0.00	0.00	2.06
GRASS ROCKFISH	0.00	0.00	0.00	0.76	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.97
HALFMOON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HORN SHARK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HORNYHEAD TURBOT	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
JACK MACKEREL	0.00	0.00	0.00	0.32	0.00	0.00	1.15	2.88	0.86	0.00	0.00	0.00	5.21
JACKSMELT	8.96	8.38	8.96	7.43	0.00	0.00	0.00	0.28	0.00	0.64	1.75	3.30	39.69
KELP BASS	0.00	0.00	0.00	0.05	0.00	0.00	0.10	0.00	0.32	0.00	0.17	0.12	0.76
KELP PERCH	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
KELP PIPEFISH	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
KELPFISH	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17
NORTHERN ANCHOVY	0.37	0.35	0.37	0.87	0.78	0.75	11.15	11.02	15.14	414.67	1177.80	1858.29	3491.56
PACIFIC BUTTERFISH	1.89	1.77	1.89	0.30	0.00	0.00	1.57	12.02	1.53	0.24	0.62	1.06	22.89
PACIFIC SANDDAB	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
PACIFIC SARDINE	0.00	0.00	0.00	0.03	0.00	0.00	1.86	1.86	1.80	4.49	11.69	20.12	41.85
PILE PERCH	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
PIPEFISH	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
PLAINFIN MIDSHIPMAN	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.03
QUEENFISH	194.59	182.04	194.59	146.41	98.02	94.86	153.63	151.05	144.53	31.46	89.97	168.07	1649.22
ROCK WRASSE	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.14	0.00	0.00	0.03	0.07	0.86
ROCKPOOL BLENNY	0.00	0.00	0.00	0.13	0.00	0.00	0.08	0.03	0.08	0.00	0.02	0.23	0.56
ROUND STINGRAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUBBERLIP SEAPERCH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02

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SALEMA	0.53	0.49	0.53	4.32	0.00	0.00	11.76	8.57	2.20	0.03	9.27	0.65	38.34
SARGO	0.00	0.00	0.00	0.28	0.00	0.00	39.71	21.90	136.02	0.00	35.60	2.43	235.93
SCULPIN (Artedius sp.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SENRITA	0.00	0.00	0.00	0.03	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.03	0.16
SHINER PERCH	0.00	0.00	0.00	0.69	0.00	0.00	0.02	0.56	0.04	0.00	0.01	0.04	1.36
SLOUGH ANCHOVY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
SPECKLEFIN MIDSHIPMAN	8.09	7.57	8.09	0.90	0.47	0.45	4.59	6.63	5.62	0.00	0.77	0.00	43.18
SPOTFIN CROAKER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.78
SPOTTED KELPFISH	0.00	0.00	0.00	0.01	0.00	0.00	0.08	0.00	0.00	0.00	0.03	0.00	0.11
SPOTTED TURBOT	0.00	0.00	0.00	0.08	0.00	0.00	0.12	0.01	0.04	0.00	0.11	0.28	0.65
STAGHORN SCULPIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.03
STRIPED KELPFISH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.14
TOPSMELT	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.52	0.93	2.70	6.11	10.31
TREEFISH	1.52	1.42	1.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.46
WALLEYE SURFPERCH	0.00	0.00	0.00	2.18	1.05	1.02	0.27	0.25	0.05	0.00	1.38	1.75	7.96
WHITE CROAKER	0.00	0.00	0.00	2.19	0.00	0.00	4.18	10.83	1.86	0.00	0.89	1.67	21.61
WHITE SEA BASS	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	1.37	0.00	0.10	0.04	1.69
WHITE SEAPERCH	0.00	0.00	0.00	0.37	0.19	0.18	0.02	0.34	0.05	0.00	0.71	0.16	2.02
YELLOWFIN CROAKER	0.00	0.00	0.00	0.03	0.00	0.00	11.55	62.53	10.36	0.94	7.59	10.84	103.83
ZEBRA PERCH	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.46	0.00	0.00	0.00	0.00	0.79
	216.11	202.17	216.11	180.53	100.50	97.26	260.16	300.59	340.01	454.87	1354.89	2086.82	5810.00

APPENDIX D.

**Estimated Monthly Number of Fish Impinged
at SONGS Unit 3 in 2001.**

Appendix D. Estimated Monthly Number of Fish at SONGS Unit 3 in 2001

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
BARRACUDA	0	0	0	0	0	0	0	0	0	116	69	31	216
BARRED SAND BASS	0	0	0	0	0	0	0	6	14	0	29	76	125
BLACK CROAKER	0	0	0	0	0	0	0	0	0	32	43	31	106
BLACK PERCH	0	0	0	0	0	9	2	2	0	3	0	0	16
BLACKSMITH	0	0	0	0	0	0	3	4	0	2	14	0	23
CABEZON	0	0	0	0	0	3	1	0	0	0	0	0	4
CALIFORNIA CORBINA	0	0	0	0	0	0	0	0	0	1	0	0	1
CALIFORNIA GRUNION	0	0	0	0	0	0	0	0	0	69	60	62	191
CALIFORNIA HALIBUT	0	0	0	0	0	0	1	0	0	11	5	0	17
CALIFORNIA SCORPIONFISH	0	0	0	0	0	1	3	2	0	2	5	0	13
CHUB MACKEREL	0	0	0	15	12	34	2	0	0	4	1	0	68
DEEP BODY ANCHOVY	12	25	31	0	0	0	0	531	0	475	434	372	1881
GARIBALDI	0	0	0	0	0	0	3	1	0	1	1	0	6
GIANT KELPFISH	0	0	0	0	0	0	127	130	120	5	4	0	386
GIANT SEABASS	0	0	0	0	0	0	0	1	0	2	0	0	3
HORN SHARK	0	0	0	0	0	0	0	0	0	1	0	0	1
JACK MACKEREL	0	0	0	0	0	0	221	237	210	6	4	0	678
JACKSMELT	73	151	187	30	25	60	1	5	0	33	33	31	630
KELP BASS	0	0	0	0	0	0	0	1	0	12	9	0	22
NORTHERN ANCHOVY	6	13	16	2490	2072	4983	56981	71207	55085	333303	342033	319006	1187193
PACIFIC BUTTERFISH	6	13	16	0	0	0	1004	987	900	9	6	0	2940
PACIFIC SARDINE	0	0	0	0	0	0	837	837	810	1395	1353	1395	6627
PILE PERCH	0	0	0	0	0	0	0	1	0	0	0	0	1
PIPEFISH	6	13	16	0	0	0	0	0	0	0	0	0	34
PLAINFIN MIDSHIPMAN	0	0	0	0	0	0	0	0	0	31	30	31	92
QUEENFISH	8085	16710	20712	5415	4505	11222	69255	69654	65886	42275	42659	41542	397919
ROCK WRASSE	0	0	0	0	0	0	1	2	0	0	0	0	3
ROCKPOOL BLENNY	0	0	0	15	12	33	3	4	0	33	35	31	166
ROUGHCHEEK SCULPIN	0	0	0	0	0	0	0	1	0	0	0	0	1
ROUND STINGRAY	0	0	0	0	0	0	1	0	0	31	30	31	93
RUBBERLIP SEAPERCH	0	0	0	30	25	60	0	0	0	0	2	0	117
SALEMA	24	50	62	0	0	678	4915	114	30	114	73	31	6092
SARGO	0	0	0	0	0	10	52	1569	0	187	30	0	1848
SENORITA	0	0	0	0	0	3	0	1	0	0	1	0	5
SHINER PERCH	0	0	0	0	0	2	32	72	30	3	2	0	141
SPECKLEFIN MIDSHIPMAN	0	0	0	15	12	30	1	0	0	33	30	31	152
SPOTTED KELPFISH	0	0	0	0	0	0	6	1	0	0	3	0	10
SPOTTED SAND BASS	0	0	0	0	0	0	5	0	0	0	0	0	5
SPOTTED TURBOT	0	0	0	0	0	0	0	0	0	3	9	0	12
TOPSMELT	0	0	0	0	0	0	31	39	30	32	31	31	194
WALLEYE SURFPERCH	0	0	0	60	50	132	56	39	30	13	23	0	403
WHITE CROAKER	12	25	31	180	150	361	426	746	270	174	443	93	2911
WHITE SEA BASS	0	0	0	0	0	0	0	0	0	15	9	0	24
WHITE SEAPERCH	0	0	0	0	0	1	73	75	60	36	43	31	319
YELLOWFIN CROAKER	0	0	0	15	12	37	2327	2321	0	111	67	0	4890
ZEBRA PERCH	0	0	0	0	0	0	2	1	0	0	0	0	3

8225 16999 21072 8265 6876 17659 136378 148599 123460 378602 387671 362780 1616585

APPENDIX E.

**Estimated Monthly Catch in Kilograms of Fish
at SONGS Unit 3 in 2001.**

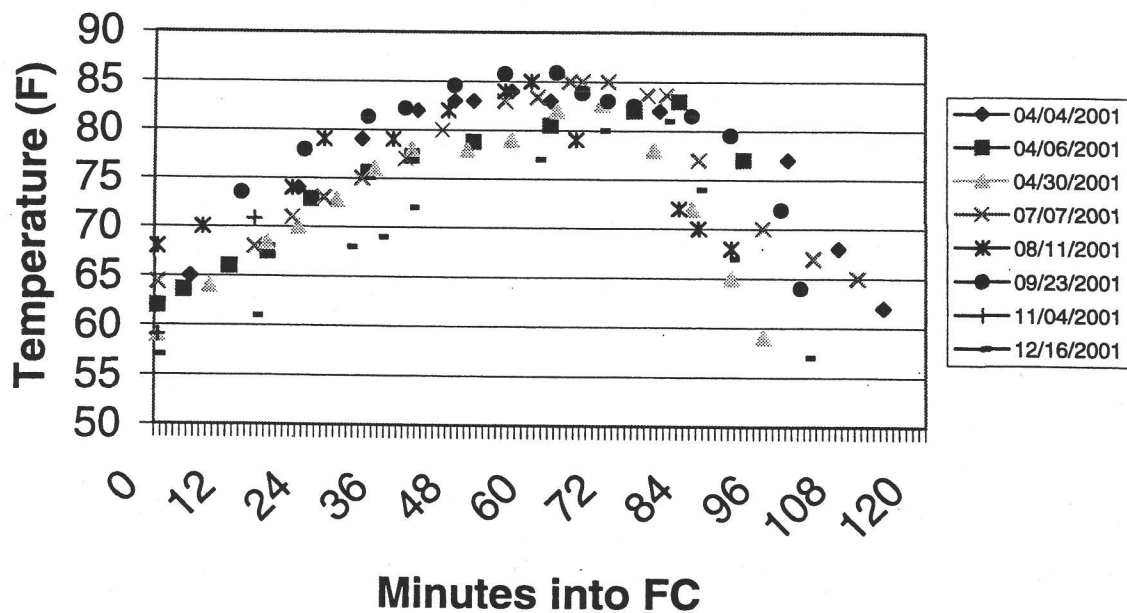
Appendix E. Estimated Monthly Catch in Kilograms at SONGS Unit 3 in 2001

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
BARRACUDA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.42	2.04	0.43	4.90
BARRED SAND BASS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.18	2.79	0.00	2.78	6.50	0.00	13.25
BLACK CROAKER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.37	0.19	0.80
BLACK PERCH	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.05	0.05	0.00	0.45	0.00	0.00	1.26
BLACKSMITH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.04	0.00	0.04	0.28	0.00	0.42
CABEZON	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.07	0.00	0.00	0.00	0.00	0.00	0.99
CALIFORNIA CORBINA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.06
CALIFORNIA GRUNION	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.39	0.40	1.23
CALIFORNIA HALIBUT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.78	0.41	0.00	1.30
CALIFORNIA SCORPIONFISH	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.20	0.03	0.00	0.89	0.26	0.00	1.53
CHUB MACKEREL	0.00	0.00	0.00	1.12	0.94	2.54	0.24	0.00	0.00	0.00	1.02	0.16	0.00	6.03
DEEP BODY ANCHOVY	0.12	0.24	0.30	0.00	0.00	0.00	0.00	0.53	0.00	0.00	4.58	4.05	3.16	12.97
FINESCALE TRIGGERFISH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GARIBALDI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.00	0.05	0.04	0.00	0.15
GIANT KELPFISH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	1.15	0.72	0.18	0.19	0.00	3.16
GIANT SEABASS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	8.55	0.00	0.00	23.55
HORN SHARK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47	0.00	0.00	1.47
JACK MACKEREL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.47	4.07	2.10	0.33	0.25	0.00	9.22
JACKSMELT	6.27	12.95	16.06	0.75	0.62	1.50	0.01	0.28	0.00	0.00	1.02	1.07	0.93	41.46
KELP BASS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.96	0.08	0.00	1.27
NORTHERN ANCHOVY	0.05	0.10	0.12	5.62	4.68	11.28	137.10	137.03	132.61	1120.42	1170.29	1102.57		3821.88
PACIFIC ANGEL SHARK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PACIFIC BUTTERFISH	0.14	0.29	0.36	0.00	0.00	0.00	0.00	27.17	26.75	23.82	0.30	0.14	0.00	78.97
PACIFIC SARDINE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.31	8.31	8.04	76.23	73.91	76.23	251.04
PILE PERCH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
PIPEFISH	0.01	0.01	0.02	0.00	0.00	0.00	5.05	25.73	35.51	0.00	20.55	36.70	0.00	123.57
PLAINFIN MIDSHIPMAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.98	2.88	2.98	8.83
QUEENFISH	45.85	94.76	117.46	63.07	52.47	131.20	834.62	844.41	782.83	423.74	426.86	403.18		4220.45
ROCK WRASSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.44	0.00	0.00	0.00	0.00	0.55
ROCKPOOL BLENNY	0.00	0.00	0.00	0.06	0.05	0.15	0.00	0.01	0.01	0.00	0.21	0.21	0.19	0.89
ROUGHCHEEK SCULPIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
ROUND STINGRAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	1.27	1.23	1.27	4.15
RUBBERLIP SEAPERCH	0.00	0.00	0.00	0.07	0.06	0.15	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.51
SALEMA	0.17	0.35	0.44	0.00	0.00	1.07	38.02	424.68	1.08	4.08	1.09	0.03		471.00
SARGO	0.00	0.00	0.00	0.00	0.00	2.28	14.13	440.83	0.00	43.20	2.51	0.00		502.95
SENORITA	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.07	0.00	0.00	0.02	0.00		0.11
SHINER PERCH	0.00	0.00	0.00	0.00	0.00	0.01	0.29	0.86	0.27	0.05	0.02	0.00		1.50
SPECKLEFIN MIDSHIPMAN	0.00	0.00	0.00	0.30	0.25	0.60	0.28	0.00	0.00	0.00	2.55	1.17	1.21	6.35
SPOTTED KELPFISH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.00	0.01	0.00	0.08
SPOTTED SAND BASS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.46	0.00	0.00	0.00	0.00	0.00	1.46
SPOTTED TURBOT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.00	0.10
TOPSMELT	0.00	0.00	0.00	0.52	0.44	1.05	0.00	0.25	0.00	0.00	0.65	0.62	0.62	4.15
WALLEYE SURFPERCH	0.00	0.00	0.00	0.48	0.40	1.51	0.82	0.66	0.33	0.59	0.69	0.00		5.49
WHITE CROAKER	0.21	0.43	0.53	0.93	0.77	1.86	6.61	22.43	2.73	2.72	7.53	0.37		47.13
WHITE SEA BASS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.70	0.67	0.00	2.37
WHITE SEAPERCH	0.00	0.00	0.00	0.00	0.00	0.13	0.90	1.06	0.78	0.89	1.54	0.43		5.73
YELLOWFIN CROAKER	0.00	0.00	0.00	2.79	2.32	6.95	1015.33	822.40	0.00	16.45	6.16	0.00		1872.40
ZEBRA PERCH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.17	2.25	0.00	0.00	0.00	0.00	3.42
TOTAL	52.81	109.14	135.29	75.73	63.01	169.12	2117.82	2792.18	955.31	1744.88	1750.64	1594.19		11560.10

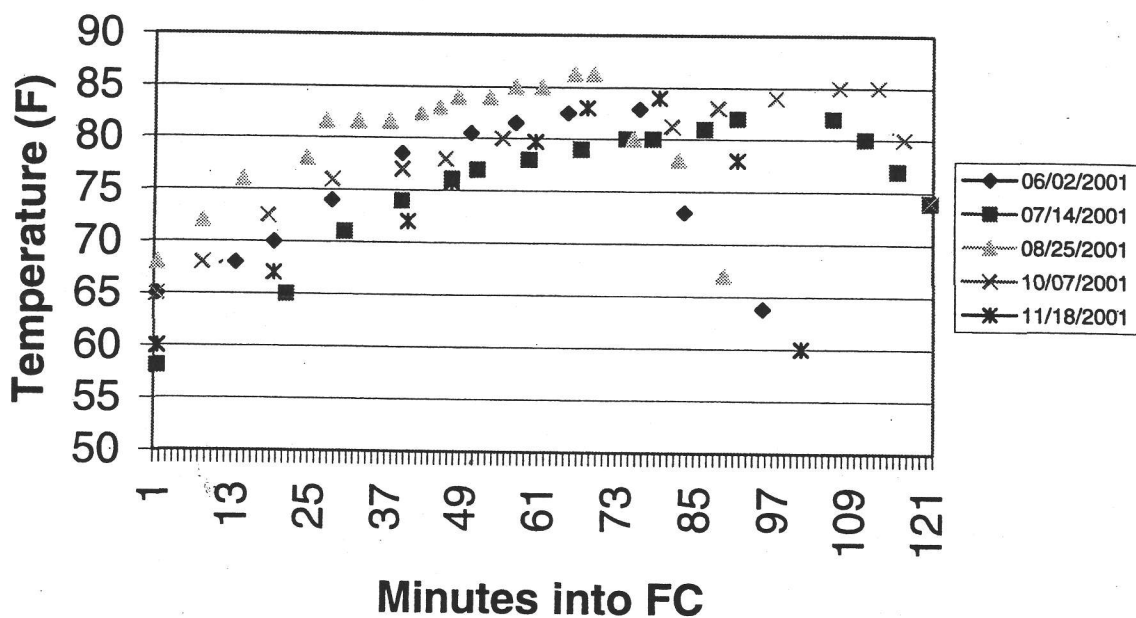
APPENDIX F.

Graphs Of Temperature Curves for Fish Chases At SONGS Units 2 and 3 in 2001

Unit 2 Fish Chase Temperature



Unit 3 Fish Chase Temperature



APPENDIX G.

Summary of Fish Released During Fish Chase Operations (By Species)

Appendix G. Summary of Fish Released During Fish Chase Operations (By Species)

Common Name	Unit 2 Fish Chase		Unit 3 Fish Chase		Unit 2 Heat treat		Unit 3 Heat treat		% Returned	% Returned
	Number	Kgs	Number	Kgs	Number	Kgs	Number	Kgs	by Count	by Biomass
BARRACUDA					1	0.016	6	0.169	0.00%	0.00%
BARRED SAND BASS	163	34.543	110	24.77	58	11.754	63	11.409	69.29%	71.92%
BASKETWEAVE CUSK-EEL					3	0.012	9	0.173	0.00%	0.00%
BAT RAY	1	0.35	4	54.5					100.00%	100.00%
BLACK CROAKER	9	1.682	2	0.12	24	2.659	15	1.121	22.00%	32.28%
BLACK PERCH	65	5.383	10	1.188	60	3.003	29	2.293	45.73%	55.37%
BLACKSMITH	8	0.326			22	0.59	34	0.345	12.50%	25.85%
BOCACCIO					1	0.003	3	0.029	0.00%	0.00%
BROWN ROCKFISH	2	0.81			3	0.14			40.00%	85.26%
CABEZON	11	1.304	7	0.42	46	2.736	58	2.705	14.75%	24.06%
CALIFORNIA BUTTERFLY RAY							1	0.344	0.00%	0.00%
CALIFORNIA CORBINA	36	8.36	104	25.12	1	0.048	1	0.201	98.59%	99.26%
CALIFORNIA ELECTRIC RAY	1	0.4					1	12.2	50.00%	3.17%
CALIFORNIA GRUNION					60	0.831	17	0.133	0.00%	0.00%
CALIFORNIA HALIBUT	1	0.18			3	1.04	5	0.813	11.11%	8.85%
CALIFORNIA LIZARDFISH	1	0.17							100.00%	100.00%
CALIFORNIA SCORPIONFISH	42	4.817	17	2.151	29	3.431	15	1.485	57.28%	58.63%
CALIFORNIA SHEEPHEAD	1	0.25			2	0.433	2	0.738	20.00%	17.59%
CHUB MACKEREL			2	0.13			29	2.121	6.45%	5.78%
CREVICE KELPFISH							3	0.015	0.00%	0.00%
DEEP BODY ANCHOVY					97	1.538	212	2.995	0.00%	0.00%
DIAMOND TURBOT			2	0.35					100.00%	100.00%
DWARF PERCH							2	0.01	0.00%	0.00%
ENGLISH SOLE							2	0.008	0.00%	0.00%
FINESCALE TRIGGERFISH			1	2	1	1.9	3	5.36	20.00%	21.60%
GARIBALDI	1	0.33							100.00%	100.00%
GIANT KELPFISH	11	0.27	5	0.44	37	1.168	19	0.663	22.22%	27.94%
GIANT SEABASS			6	63.5	1	19.2			85.71%	76.78%
GRASS ROCKFISH					2	0.188			0.00%	0.00%
GRAY SMOOTHHOUND	2	3.25							100.00%	100.00%
HALFMOON			3	0.86			1	0.03	75.00%	96.63%
HORN SHARK	2	5					1	2.165	66.67%	69.78%
JACK MACKEREL	1	0.05			244	5.337	394	11.095	0.16%	0.30%
JACKSMELT	3	0.73	45	3.538	180	12.981	295	18.49	9.18%	11.94%
KELP BASS	22	3.74	111	27.415	16	0.063	37	4.096	71.51%	88.22%
KELP PIPEFISH					5	0.008	3	0.008	0.00%	0.00%
LEOPARD SHARK			1	0.3					100.00%	100.00%
MUSSEL BLENNY							5	0.041	0.00%	0.00%
NORTHERN ANCHOVY	2460	28.305	3232	31.739	1743	16.109	36749	115.932	12.88%	31.26%
PACIFIC BUTTERFISH	3	0.034	1	0.03	54	0.965	150	2.846	1.92%	1.65%
PACIFIC CUTLASSFISH					1	0.248			0.00%	0.00%
PACIFIC SARDINE	3	0.122	14	0.634	296	15.504	162	9.238	3.58%	2.96%
PILE PERCH					2	0.044	1	0.383	0.00%	0.00%

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Common Name	Unit 2 Fish Chase		Unit 3 Fish Chase		Unit 2 Heat treat		Unit 3 Heat treat		% Returned	% Returned
	Number	Kgs	Number	Kgs	Number	Kgs	Number	Kgs	by Count	by Biomass
PIPEFISH					4	0.004	1	0.001	0.00%	0.00%
PLAINFIN MIDSHIPMAN			1	0.1	5	1.076			16.67%	8.50%
QUEENFISH	970	26.796	5,238.00	65.824	6056	155.823	17732	512.091	20.70%	12.18%
ROCK WRASSE	6	0.85	3	0.1	18	2.426	5	0.548	28.13%	24.21%
ROCKFISH	2	0.13			1	0.002			66.67%	98.48%
ROCKPOOL BLENNY					40	0.274	193	0.486	0.00%	0.00%
ROUND STINGRAY	3	1.2	1	0.1					100.00%	100.00%
SALEMA	1698	126.484	7012	476.962	608	42.644	989	59.571	84.51%	85.51%
SARGO	1621	510.838	5422	1334.392	1179	295.432	1612	414.432	71.62%	72.22%
SENRORITA					13	0.255			0.00%	0.00%
SHINER PERCH			2	0.06	226	3.169	145	1.757	0.54%	1.20%
SHOVELNOSE GUITARFISH	2	6	7	29	1	4	2	7	75.00%	76.09%
SMOOTHOUND	1	0.1							100.00%	100.00%
SPECKLED SANDDAB					7	0.015			0.00%	0.00%
SPECKLEFIN MIDSHIPMAN	12	5.17			3	1.414	7	2.088	54.55%	59.62%
SPOTFIN CROAKER	75	38.83	932	488.385	6	2.518	32	15.672	96.36%	96.66%
SPOTTED KELPFISH					2	0.008	4	0.059	0.00%	0.00%
SPOTTED TURBOT			1	0.2	14	0.136	11	0.143	3.85%	41.75%
STAGHORN SCULPIN			1	0.02					100.00%	100.00%
STRIPED KELPFISH					3	0.031	2	0.016	0.00%	0.00%
TOPSMELT	3	0.121	46	2.34	635	22.615	183	7.199	5.65%	7.63%
VERMILIAN ROCKFISH	1	0.01					3	0.023	25.00%	30.30%
WALLEYE SURFPERCH	32	0.85	26	0.67	185	4.475	225	5.031	12.39%	13.79%
WHITE CROAKER	196	5.76	291	5.966	1428	28.901	1528	28.34	14.14%	17.00%
WHITE SEA BASS	5	4.14	30	9.839	4	2.246	25	3.194	54.69%	71.99%
WHITE SEAPERCH	6	0.148	3	0.25	30	0.439	40	0.689	11.39%	26.08%
WOOLY SCULPIN					1	0.003			0.00%	0.00%
YELLOWFIN CROAKER	140	48.75	2189	697.715	102	32.637	1181	401.112	64.48%	63.25%
ZEBRA PERCH	117	70.2	37	20.26	4	2.4	2	1.11	96.25%	96.26%
Totals	7739	947	24919	3371	13567	705	62249	1670	30.11%	64.52%

APPENDIX H.

Species of Special Interest Impinged or Entrained During 2001

	42	43	Total
Impinged	5810	11560	17370
Entrained	947	3571	4518
Head #	705	1670	2375
			24063

6693 32.2% of total

Many researchers and resource managers have found impingement data to be a valuable tool in understanding the dynamics of marine organisms in near-shore coastal waters. Though not a required part of this marine environmental monitoring report, the following information is provided for those who may be interested:

Species of Special Interest entrained in 2001

Species	Reason for concern	Impinged		Returned		Total
		Unit 2	Unit 3	Unit 2	Unit 3	
Fish						
California barracuda	Important sport and commercial fish	27	216	0	1	244
California halibut	Important sport and commercial fish	15	17	5	2	39
Finescale triggerfish	Rare in California	0	0	0	1	1
Garibaldi	Protected in California	1	6	2	1	10
Giant seabass	Protected in California	1	3	3	9	16
Kelp bass	Important recreational fish	36	22	14	66	138
White Seabass	Important sport and commercial fish	15	24	8	69	116
Mammals and Turtles						
California sea lion	Marine Mammal Protection Act	12	6	2	1	21
Harbor seal	Marine Mammal Protection Act	2	0	4	0	6